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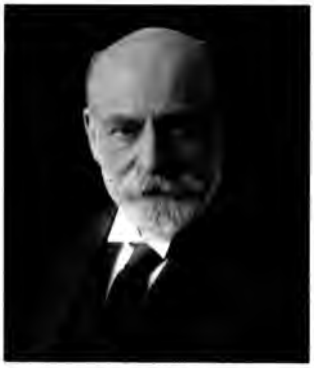

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THE GEOLOGICAL SURVEY OF CALIFORNIA.

AN

ADDRESS

DELIVERED BEFORE THE

LEGISLATURE OF CALIFORNIA,

AT

SACRAMENTO, TUESDAY EVENING, MARCH 12TH, 1861.

BY J. D. WHITNEY,
STATE GEOLOGIST.

TO WHICH IS APPENDED A COPY OF THE ACT AUTHORIZING THE SURVEY.

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ADDRESS.

THE people of California, through their representatives in the Senate and Assembly, at their last session authorized a geological survey of the State, and appointed the person who now has the honor of addressing you to take charge of this important work. By the terms of the Act "Creating the office of State Geologist, and defining the duties thereof," an Act which, in the opinion of the most eminent scientific men of the country, is most admirably comprehensive, and has never been surpassed in the judiciousness of its requirements by any Act of a similar character passed by any of the State Legislatures, the State Geologist is required, at the beginning of each session of the Legislature, as near as may be, to present a report of progress, "in which the operations of the geological survey during the preceding year shall be set forth, and its more important practical results made public."

As hardly three months have elapsed since the work of the geological survey was commenced, the first report which I have to make will hardly be more than a statement of the fact that we have taken the field, and that we have made a beginning of our labors. A synopsis of our movements up to this time will, however, be furnished, in accordance with the Act above cited.

In the meantime, having been honored by an invitation to appear before you, gentlemen of the Senate and Assembly, and to address you on the work in which we are engaged, I am happy to have the opportunity of setting forth some facts in reference to the mining interests of the United States, sketching the history of the development of our metallic and mineral wealth, with especial reference to what has been accomplished by the state geological surveys, and endeavoring to show the immediate and prospective value of such a work as we have just entered on, to the State of California.

In reply to the question—What is geology? I answer: The application of various departments or branches of science to the study of the past history and present condition of the earth. By history, we mean, of course, physical and natural history, not political; the record of the operation of natural causes, not of such as have been effected under the influence or by the agency of man. Almost every branch of science is, in its turn, called upon to aid in the prosecution of geological researches. By astronomical observation and measurements, combined with mathematical calculations, we are constantly getting nearer and nearer to the exact form, size and weight of the earth. What a vast amount of research has been expended on the determination of these elementary questions, giving us the first and most important general ideas with regard to that member of the solar system on which we are placed! By the aid of laws derived from physical researches, we draw conclusions with regard to the condition of the interior of our planet; that it is an intensely heated fluid mass, surrounded by a solid crust, which has formed on it by gradual cooling, and which is not unfrequently violently moved and torn asunder by the reaction of the molten matter below, giving rise to the phenomena of volcanoes and earthquakes. Chemistry and mineralogy tell us of what materials this consolidated crust is made up, while botany and zoology are applied to the study of the remains of plants and animals, so abundantly imbedded in the rocks, and most of which are widely different in form and structure from any now living on the earth. As thus applied, fossil botany and zoology, or palæontology, as the study of extinct organic forms, or petrifactions, is called, become of the greatest interest and importance to the geologist—since it is by the character of the organic remains found in them, that rocks are classified as to their geological age and position, which is the first problem which the geologist has to solve when examining the structure of a new region.

The most superficial examination of the earth's crust shows that it is made up of rocks of various kinds, such as granite, slates, limestone, shales and sandstones; not thrown together promiscuously, but arranged in a certain order and position with reference to each other.

Some of these rocks occur in irregular mountain masses, or in long lines traversing other formations, and evidently filling fissures, formed by subterranean disturbances, such as we see taking place at the present time, in regions liable to powerful earthquake shocks. This class of rocks is called igneous or intrusive; among which are granite, trap, basalt and lava. These are also known as the unstratified rocks, as distinguished from such as have been accumulated by the action of water, and which are spread out in regular layers, or strata, and which must have been originally deposited in a horizontal position, or nearly so. In the stratified rocks, we frequently find great numbers of fossils of various kinds—shells, fragments of corals, impressions of fishes, bones of animals, or remains of plants, showing that while the strata in which these occur were in process of formation, animal or vegetable life was going on. These remains are sometimes those of animals which must have lived in salt water; at other times, such as could only have existed in fresh water; or again, such as lived on the dry land. In closely examining the succession of layers exposed along the face of a cliff, or passed through in sinking a shaft or digging a well, we may find that they are made up of a variety of different materials, such as sandstone, clay, gravel, limestone, coal or fire clay, each set of beds containing a different set of fossils from that which lies above and below it; and this same order of succession may be found extending over a large region of country—so that one may know beforehand exactly what rocks he will pass through in sinking a shaft, and what kind of shells or plants he will find in each successive layer.

By closely investigating the rocks in different parts of the world, studying and comparing the fossils which they contain, and the order in which they are arranged, geologists have found that the strata of which the earth's crust is made up can be arranged in a regular series, or in chronological order, which is everywhere the same, and which forms the basis of geological science.

To exhibit the succession of changes which the earth's surface has undergone, to unfold the structure of the rocky masses of which it is made up, to show what varied and wonderful forms of life have appeared upon it, lived for a certain period and then passed away to be succeeded by others of still more complicated and wonderful structure, to trace out all the steps by which our planet has passed from chaotic desolation up to order, life and beauty as at present exhibited on its surface; in short—to unfold the history of the Creation, or at least to do as much toward it as our limited nature is capable of; this is the aim of the theoretical geologist, the grand result for which so many are working in every part of the world. And what more interesting problem can be presented to the human mind for solution, "leading us back from our own position and connection with this planet, through all its former phases and conditions, to the time when it came fresh and glowing from the hand of the Creator?" We have learned through geological investigations that the present condition of things is but a link in a series of infinite progression; that there was a time when neither animals nor plants existed on the surface of the earth; that creative power first called into existence organic forms of comparatively simple structure; that through an innumerable series of ages sets of these succeeded each other, each of which was, on the whole, more highly organized than that which preceded it, until finally man himself, "the noblest work of God," made his appearance. Undoubtedly, the science of geology has connected itself with those problems which most deeply interest the human race, and, together with astronomy, has enlarged our ideas of the plan of creation to a scale of vastness which the human mind is hardly capable of grasping. What astronomy has done for space, geology has done for time; the one gives us the idea of infinite distance and magnitude in the starry heavens—the other, of almost infinite duration of time in the immense cycles of changes which our own planet has undergone.

But the science of geology has its practical side as well as its theoretical; and the State, while thus incidentally aiding in the progress of the science, and adding to the sum of human knowledge, has to look chiefly to the economical results of a geological survey, and to the laying down of such principles, and the gathering of such information as may be of practical value to those who are more or less directly dependent on the development of its mineral resources.

To discover and classify the mineral and metallic treasures which are buried beneath the surface of the earth, to ascertain their position and determine their abundance, so as to make them available for the industrial purposes of life, is the business of the geological surveyor.

It is for this purpose chiefly that geological surveys have been organized and carried on during the last thirty years, under Government authority and at the public expense, in almost every country of Europe, as well as in the colonies and dependencies of European powers in Asia, Africa and Australia, and also in all the United States without exception.

The first work of this kind was set on foot in France, as early as 1822, when the construction of a geological map was ordered by the Government and executed by the Professors of the School of Mines with consummate ability. In that country, where everything which can be done to promote science, and at the same time advance the material interests of the State, is on a scale of imperial munificence, there is a special department of the Government to which the care of the mining industry of the nation is intrusted, and a mining school, where this branch of practical science is assiduously cultivated. To this school young men from all parts of the world are admitted, to enjoy all the advantages which the most learned Professors, costly collections and fully equipped laboratories can offer, and without payment of any fee whatever. Only those Frenchmen, however, are allowed to become candidates for the degree of Mining Engineer who have previously passed through the three years severely mathematical course of the Polytechnic School, and who have graduated at that institution with the highest honors. Being thus prepared, and having successfully passed through the three years course at the School of Mines, they receive the degree of Mining Engineer, and remain in the service of the State for life, being employed in the superintendence of mines and the construction of important public works, everything of this kind being in France under the immediate supervision of the Government. One of the graduates of this school has recently been in California, sent here by the Government to report on the mining interests of the State.

In England, a geological survey was commenced in 1836, and has been carried on ever since, in connection with the geographical surveys in progress since that time. The present Director is Sir Roderick Murchison, perhaps the most eminent living geologist. The British survey has been made the basis of the "National School of Economical Geology," as it is called, or of the practical application of this science to the mining and manufacturing interests of the country. A magnificent building has been erected in Jermyn street, London, in which a complete museum of all the mineral productions, rocks and fossils of the United Kingdom has been gathered together. Here you may see specimens of all the building materials, ornamental stones, useful ores, furnace products, porcelain clays, coals, salt, gypsum, and in short, of every mineral product which is in any way made available in the arts, all arranged in the most admirable manner for inspection and examination. Here plans and sections of all the mines wrought in the country, so far as they can be obtained, are preserved, and a special officer, called the "Keeper of Mining Records," is constantly employed in collecting and arranging the statistics of all mining and mineral products; so that, at the end of the year, an accurate picture of the condition of this branch of industry is laid before the public. In the School of Economic Geology, courses of lectures on geology and all the kindred sciences, with especial reference to their practical application, are given by the most eminent men in each department, all of which are open to the public on payment of a merely nominal fee. In the evening, lectures are given, for the especial benefit of artisans, in those branches most nearly connected with metals and minerals.

The same fostering care is extended by all the other principal States of Europe to the mining interests, and Government mining schools exist in various parts of Germany, and in Russia and Sweden. That of Freiberg, in Saxony, is justly celebrated for the ability of its professors; and young men from every part of the world, including North and South America, are always studying here.

In our own country the first geological survey ever undertaken was in 1824, of the country bordering the

Erie canal—a wild, inaccessible region in those days. This work was executed at the expense of Stephen Van Rensselaer. Previous to this, however, as early as 1809, William Maclure had commenced single-handed and alone the work of making a geological map of the United States, to which he devoted many years of labor, laying the foundation of the science in this country, and giving the first general idea with regard to the mineral structure of an immense extent of our territory.

North Carolina was the first State to order a geological survey, and this was as early as 1824, before any other country, excepting France, had entered on such work. At this time the science on this side of the Atlantic was too much in its infancy to allow of such a work being made very thorough or complete. But every year was adding largely to the public interest in the developments of geological research in Europe; and in 1830, Massachusetts ordered a comprehensive survey of the natural history of the State in all its departments, this being the first thorough investigation of this kind undertaken in any of the States; and the reports of the various persons charged with the different branches of investigation have been works of classic authority ever since their publication. The volumes by Mr. Emerson, on the forest trees of the State, and by Dr. Harris, on the insects injurious to vegetation, may be especially referred to as of great interest and importance. Massachusetts, having no deposits of metalliferous ores worthy of being worked, with the exception of a few unimportant iron mines on her western borders, the strictly geological part of the survey was of less practical value. The munificent donation of a quarter of a million of dollars, given a short time since, partly by the State and partly by individuals, to erect a building as a "Museum of Comparative Zoology," in which the collections of Professor Agassiz, such as are already gathered, or are yet to be brought together by that indefatigable worker, to illustrate the history of the animal kingdom, are to be deposited, shows that the value of this class of investigations is appreciated by the people of that State.

The States of New York, Pennsylvania, Virginia and Ohio commenced their surveys soon after that of Massachusetts was begun; and one by one every State in the Union, unless it be one or two of those most recently admitted, has followed their example. In some the work has been completed and the final results published; in others, the surveys are still going on, while in a few cases the work has been suspended, either from the death of the person in charge, or from other causes. Thirteen States have now their surveys in progress, some of which are near completion.

The United States Government has also, in its federal capacity, in the necessary geographical examinations of the immense territories which have been acquired from time to time by purchase or otherwise, done much for geology. The only strictly geological surveys, however, made under national authority, were those of the Lake Superior region, by Mr. Foster and myself, and of the

Chippewa Land District in Wisconsin, Minnesota and Iowa, by Dr. D. D. Owen, whose death we have recently been called to deplore.

It is much to be regretted that no attempts have been made by the United States to collect the statistics of our mining industry; our census returns, imperfect and erroneous as they notoriously are in reference to other matters, become ridiculously so when they relate to mining or metallurgy. All the reliable information in this branch of our national statistics has been obtained through the labor of private individuals. In 1852, 1853 and 1854, I traveled through twenty-five States, for the purpose of collecting facts with regard to the development of our mining interests, and embodied the results in a work published in 1854, entitled "The Metallic Wealth of the United States described and compared with that of other Countries," in which I have given as accurate a summing up of the yield of all the metals throughout the world as could be obtained by investigation of all the published official records, aided by personal inquiries and a voluminous correspondence at home and abroad.

From the information collected at that time, and from what I have since gathered in pursuit of the same object, I will present a few facts with regard to the development and present condition of our mining resources, which will, I trust, be of sufficient interest to command your attention for a short time, since this is a subject which is closely connected with the interests of this State.

The records of mining in the United States and on the American continent form one of the most interesting chapters in our history. The expectation of finding a land possessing greater treasures of gold and silver than existed elsewhere, led to the discovery of the New World, and was the predominating motive in its settlement. These golden dreams were not destined to be disappointed, for a land had indeed been reached whose realities of metallic wealth were capable of satisfying an almost boundless ambition. Under Spanish dominion, the mines of Mexico and South America poured forth their treasures of silver and gold, and deluged Europe with an amount of these metals far beyond anything before dreamed of. The history of Spanish mining in America is too well known to require recapitulation here; confined exclusively to the metals styled precious, it conferred no lasting happiness or prosperity on either country.

It was almost a century after the South American mines were opened before the less attractive shores of the Northern Atlantic began to be settled. Mining formed no part of the object of the colonists of that region, and it was only at rare intervals that some adventurous person attempted it. Governor Winthrop, of Connecticut, seems to have been the first "prospecter," or at least the first of whose operations any records remain; he devoted a good deal of time from 1650 to 1660 to examining the metalliferous indications of the interesting region around Haddam and Middletown, in

Connecticut; and some mining appears to have been done under his direction, but not of any permanent value.

About this time the Jesuit Fathers were exploring the then far distant shores of Lake Superior, and we find in the records of their journeys frequent allusions to the copper of that region, which, occurring as it does in the native state, and not unfrequently found in loose masses of large size, along the shore of the lake, could hardly have escaped the notice of such careful observers as Allouez and Marquette. Hundreds and perhaps thousands of years before this, the whole Lake Superior region had been the scene of active mining operations, carried on, probably, by the same race which built the mounds and earthworks so abundantly scattered over the Northwest. These ancient miners had neither powder nor tools of iron or steel; but with incredible perseverance, and no small amount of ingenuity, they carried their excavations to a depth sometimes as great as fifty feet in the solid rock, and undoubtedly raised large amounts of copper. In one instance which came under my own observation, a mass of copper weighing nearly seven tons had been dug out of the solid rock and raised several feet above its original position, blocked up on pieces of wood, and then abandoned for some unknown reason. After this was done, the excavation, which was about fourteen feet deep, had become filled gradually with dirt washed in around it, and forest trees hundreds of years old had grown over it and decayed, to be succeeded by others, during a period of unknown but certainly very great length. Hardly a single vein has ever been discovered on the south shore of Lake Superior, or even on the distant and almost inaccessible island on the north side, called Isle Royale, which had not previously been opened and worked along the surface, at some points, by these ancient miners; and the extent of their workings is almost always a pretty sure index of the value of the lode.

Just at the beginning of the eighteenth century, a Frenchman named Le Sueur made an exploration of the Upper Mississippi region, for the purpose of discovering workable veins of the metals, and he shipped several boat loads of what he supposed to be copper ore to New Orleans, from one of the tributaries of the St. Peter's river; this ore turned out to be a kind of bluish earth or clay of no value, and nothing further came of Mr. Le Sueur's projects.

Early in the preceding century, but precisely at what time is not known, a commencement had been made of our iron manufactures by the erection of a smelting furnace on James river, in Virginia, which, however, was destroyed by the Indians in 1622. The records of the earliest growth of the iron business in the United States are very imperfect; but it appears that considerable progress had been made at the beginning of the eighteenth century, and that there were in 1715 quite a number of furnaces at work smelting in New England, Pennsylvania, Virginia and Maryland. The jealousy of the English smelters and manufacturers was soon aroused, and the result was that Parliament forbade the erection of rolling and slitting mills in this country, so that our pig iron had to cross the Atlantic to be manufactured.

The first mining company in the United States was chartered in Connecticut, in 1709, for working the deposits of copper ore at Simsbury, and mining was prosecuted here on a small scale for some years, and some ore was taken out and sent to England. Ten years later, the New Jersey copper deposits began to attract attention, and the Schuyler mine was opened, yielding a considerable quantity of rich ore near the surface. There are indications of copper at many points in the red sandstone formation of Connecticut and New Jersey, but nowhere a sufficient quantity to make anything like a permanent mine; quite enough, however, to get up a little mining fever about, as soon as the results of the last attack of the kind have been forgotten.

In 1719 and 1720, the attention of the French was directed to the Mississippi valley, and the assumed existence of the precious metals in that region was made the basis of the Law speculation or swindle—one of the most gigantic humbugs ever set agoing. A corps of mineralogists and miners was sent out to explore, and did make some discoveries of lead ore near the confluence of the Mississippi and Missouri rivers, which were feebly worked until the bursting of the bubble in France. It was not until the latter part of this century that the Missouri lead region began to be of importance.

While in possession of the French, but little regular mining was done, the ore being taken from the surface and smelted on log heaps. After the cession of Louisiana to the United States, the business grew rapidly in importance, and improved methods of mining and smelting were introduced. The lead region of the Upper Mississippi, in what is now part of the States of Wisconsin, Illinois and Iowa, and which was the most important mining district in the United States before Lake Superior and California were opened, began to be of importance about the year 1826, and in a few years was producing more of that metal than we required for our national consumption.

From 1820 to 1830 may be considered the period during which our mineral and metallic resources began to be of importance, and the United States to take a high rank as a metal-producing country. It was in 1820 that the first cargo of anthracite coal was shipped to Philadelphia—a substance which up to that time had been considered as no more combustible than so much granite. Now, Pennsylvania supplies the Eastern States and consumers within its own borders with 10,000,000 tons a year, and the quantity annually mined is rapidly increasing. During this period the smelting of iron was becoming a business of national importance; and in 1830 the United States stood next to England and France in the production of this metal.

From 1830 to 1840 was the period of the gold excitement in the Southern Atlantic States, and it was during these years that the Western lead region was producing the largest amount of that metal, or from 25,000 to 30,000 tons a year—equal to about one-fifth of the whole produce of the world—and our make of iron at the end of this decennial period had reached the important figure of 350,000 tons a year.

In 1844 the Lake Superior region was opened, and after a few years of wild excitement and hap-hazard speculation, the business of copper mining began to be vigorously and skillfully conducted, and we were no longer entirely dependent on other countries for our supplies of this important metal. During this period the application of anthracite coal to the smelting of iron was another great step toward the development of our mineral resources, and as early as 1845 we had risen to the second place as an iron-producing nation.

The great event in our mining history, and indeed, one of the great events in the world's history, was the discovery of the gold of California, in 1848. Up to this time the Pacific side of our continent had remained an uninhabited and almost unvisited region, of which we knew nothing, save what might be gleaned from an occasional scientific expedition sent across the desert plains, or the returning ship of the whaler or dealer in hides; and it seemed to require some extraordinary event to direct the tide of emigration to a land then inaccessible, except by a six months' voyage around Cape Horn, or a perilous journey, nearly as long, over unexplored and desert plains. This event came in the demonstration of the fact that, throughout a vast extent of that distant country, gold in unstinted quantity was to be had for the trouble of digging it. and that it was free to all who chose to go thither and take it. Then commenced a wandering of nations without a parallel in history. The perils and privations of the overland route were braved with indomitable energy. The Pacific was whitened with the sails of nations pressing onward to the land of gold; and, for the first time in the world's history, representatives of every people and climate hurried toward a common center of attraction.

But I need not dwell on an event of which those whom I see before me were a part; I stand in the midst of a mighty State, the figures of whose population and the development of whose material resources, the result of but little over ten years of unexampled energy and endurance, require no aid of eloquence or ornaments of rhetoric to make them deeply impressive.

The discovery of the golden treasures of California gave an immense impetus to mining adventures all over the world; it led directly to the opening of a rival gold region in Australia of almost equal magnitude and importance, and the consequent rush of emigration to that distant region, the rise of wages and immense relief to the poorer classes in England, and a general and unexampled activity in every department of commerce and manufactures throughout Europe and America.

The Atlantic States were searched from one end to the other for metalliferous deposits; many long-abandoned mines were taken up; the gold region of the Southern States became the scene of an unheard-of excitement, and the whole country seemed to swarm with promoters of mining enterprises. This general movement toward the development of our mineral resources, which took place in 1850 to 1853, was undoubtedly based in part on a sincere belief in the richness of our mines, and the possibility of new discoveries which should furnish an opportunity for profitable investment; but it must be acknowledged that a large part of the excitement had its origin in Wall street, and was the mere blowing of a prodigious bubble—a repetition of the old Lake Superior speculations of 1845–6 on a new and wider field, and on a greatly enlarged scale.

In 1854 this bubble bursted, and made sad havoc among the holders of mining stocks in the Eastern States. Since that time, the large capitalists have not been easily coaxed into investments of this kind, except with good evidence in hand of the existence of valuable deposits of ore, and the whole business has been placed on a safer and more economical basis; so that we may now look for a less noisy but far more effective development of our mineral resources than we could ever have when stock-jobbing and speculation were the only ends in view.

Let us glance at the present position of the mining interests of the United States, as compared with those of other countries.

In 1854 we stood, as we do at the present time, second only to Great Britain in the amount of our metallic produce. Reckoning the value of the metals in their crude, unwrought state, as they come from the smelter's hands, in pigs, bars or ingots, our yield for that year amounted to about $80,000,000 in value, while that of Great Britain was something over $100,000,000. If the non-metallic mineral produce of both countries were added, the difference would be much greater, as the coal raised in Great Britain is worth nearly $100,000,000 as it lies, delivered at the mine. In 1854, gold and iron made up nineteen-twentieths of the value of our yield of metals—the former almost exclusively the product of California. Comparing the value of the two metals, we find the value of the gold to have been about three times that of the iron in the form of pig metal. But it must be remembered that the value of the pig iron is immensely increased in the process of conversion into wrought iron, and in the further manufacture which it undergoes before it is brought into the final shape in which it is made available for use. It would require the whole amount of the gold which we produce to pay for the iron we consume, if it was all imported in the manufactured state. In 1854, we probably consumed 1,500,000 tons of this metal, of which over half a million tons were imported, chiefly from England, for which we paid over $20,000,000. The whole production of the world in that year was about 6,000,000 tons, of which Great Britain furnished a little over one-half, and the United States not quite one-sixth—or more exactly: Great Britain, 3,069,838 tons; the United States 841,550. In 1859, the yield of iron was probably about 8,000,000 tons, of which Great Britain furnished 3,712,904 tons, and our own country something less than 1,000,000. It is not from the lack of ore of the finest quality, or of fuel, that we are, in a measure, dependent on other countries for our supply of this metal. It is the high price of labor and the greater value of capital in this country, which gives England its advantage over us. We cannot as yet compete with that country in the production of the poorest and cheapest qualities of iron; but true economy would lead to the use of American iron in most cases where the British article is now employed, as the difference in price is more than compensated by the superior quality of our own product.

The poverty of the Middle, Western and Northwestern States in the ores of the other metals is compensated by the abundance and good quality of the iron ore and coal of that region. New England has little to boast of in the way of mineral wealth, except her granite and ice, of which the supply (especially of the latter) may well be called inexhaustible; and New York has to depend on Pennsylvania for her coal, although well supplied with iron ore. There are vast deposits of the finest quality of iron on Lake Superior and in Missouri which are hardly yet touched, but which will eventually become of the highest importance. The construction of the Pacific Railroad will give an immense impetus to the iron business, and Missouri will probably have the privilege of supplying the larger part of the metal required for that great national work, the importance of which to both sides of the continent can hardly be overestimated.

That California, or any other portion of the Pacific slope, will soon be independent of the rest of the world for her supplies of iron, is hardly to be expected, however much it might be desired. With the high prices of labor and capital ruling in this region, it would require the deposits of ore to be situated in the most extraordinarily favorable manner, with regard to fuel and a market, to be made available. For local consumption, at points distant from the coast, there may be deposits discovered which can be worked with profit, and all the light possible will be thrown on this subject during the progress of the geological survey.

The only important lead-producing region in the United States is that of the Upper Mississippi; which, however, has fallen off considerably from its former productiveness. The whole supply of this metal required for the Atlantic States is drawn from England and Spain, which countries together furnish about two-thirds of the lead of the world. We require about 30,000 tons a year at the present time to supply our wants—a quantity equal to one-fifth of all that is produced. California has a great number of veins containing sulphuret of lead, or galena—the common ore of that metal. This galena almost invariably contains a considerable amount of silver, and there is good reason to suppose that ere long this State will furnish both lead and silver in considerable quantity. Specimens of silver-lead have been brought in large numbers from the South-eastern part of the State, and the opening up of a rich mining region in that quarter would soon lead to the construction of a railroad, now so much needed to make that country more accessible. The silver-lead mines of Arizona are also represented as being likely to prove very rich, and only await facilities of transportation to become of importance.

The ores of zinc are very widely distributed over the United States, but the value of the metal is so small, compared with the skill and capital required to smelt them, that as yet the manufacture of spelter, or metallic zinc, has only been successfully carried on at one place—Bethlehem, Pennsylvania. There have been attempts made to smelt the ores of zinc which are found with those of lead, in Wisconsin and Illinois; but they have only proved that we cannot compete with foreign producers of this metal except under the most favorable conditions, such as are united in the zinc deposits of New Jersey and Pensylvania, adjacent to coal and close to the seaboard. There are several large establishments at Newark, New Jersey, and in Bethlehem, where the white oxide of zinc is made directly from the ore and with profit; as there is a large and increasing demand for the oxide for paint, which can be supplied to any extent from these mines. Belgium and Prussia are the great zinc-producing countries; they together furnish fully five-sixths of all that is made in the world, which is not less than 60,000 tons of the metal, per annum.

Zinc ore occurs in many localities in this State, it being an almost constant associate of lead and silver. No deposits of any great magnitude have yet been discovered, so far as I know, and there is no reason to suppose that this metal will form an object of mining enterprise on this side of the mountains for a long time to come.

Previous to the opening of the Lake Superior region, in 1844, there were no permanent mines of copper worked within the limits of the United States. Now we supply about two-thirds of our own consumption, which is not less than ten thousand tons a year. Large quantities of ore are imported from South America and Cuba, and smelted at Boston, New York and Baltimore, and quite recently a remarkable deposit at Acton, near Montreal, in Canada, has been opened and is producing largely. East Tennessee is another cupriferous district of some importance, and a few mines in North Carolina add a little to our national production. The amount of this metal required to supply the world has increased rapidly within the last few years, the annual production being now more than double what it was in 1830; it now reaches 70,000 tons a year, of which nearly one-half is derived from Chilian and British mines. There is reason to hope that we shall soon do more than supply our own demand of copper, and California will undoubtedly aid in bringing about this desirable result. There are several localities where rich ores are known to occur, and, as is said, in considerable quantity, and some mining has already been done at one or two points, and shipments of ore made to the smelting works at the East.

No tin has ever been mined and smelted within the limits of the United States. The ore is known to occur, outside of California, only at one locality in New Hampshire, where it forms a few narrow seams, not large enough to be worked. We are dependent chiefly on the island of Banca for our supply of this metal, in the form of ingots, or slabs, and on England for our tinned iron, of which we consume as much as all the rest of the world put together. The ore of tin has been found in some quantity in Southern California, and there is reason to hope that it may prove abundant enough to to be profitably worked. Both tin and copper are metals of so much value that their ores, if rich, may be shipped to a distant market to be smelted, and a profit still be realized.

Before the opening of the California mines of quicksilver, the world was chiefly supplied with this metal from the Spanish locality of Almaden, with the addition of small amounts from Austria and Peru. From the numerous important discoveries of its ores in California, it would appear that this State will soon be able to supply the world with quicksilver, at low prices, and with large profit to those engaged in producing it. Up to the present time, not a trace of mercury has ever been found in the rocks through the whole region to the east of the Rocky mountains; and although Mexico and Peru have numerous deposits of its ores, they have not been productive of late years, the great mine of Huancavelica having been ruined by bad management.

Until within quite a recent period there was not a single silver mine within the limits of the United States, and yet the American continent has been for centuries the principal source from which our supplies of that metal have been drawn. It is Mexico which furnishes fully four-fifths of the whole produce of the world, which in 1850 was nearly 3,000,000 lbs. troy, equal in value to about $47,000,000. Within a short period the subject of silver mining has begun to attract great attention, and the name of Washoe has already become familiar all over the world. The discoveries in Carson Valley have led to explorations all along the eastern slope of the Sierra Nevada, and many are the rumors of argentiferous lodes, of the real value of which little appears as yet to be definitely and reliably known. It seems, however, as if there could be little doubt that, among the great number of localities, some may be found worthy of immediate and extensive working; while others, in which the conditions are now less favorable, may be taken up at a future time, when the facilities of communication are greater, and the cost of labor and supplies consequently less. Although the Washoe mines are supposed to be without the limits of the State, yet, as the business all passes this way, and must continue to do so, their development is more a matter of interest to California than to any other State.

The opening of California, and the discoveries in Australia, which followed only three years later, effected an astonishing change in the amount of gold raised throughout the world. For a long time previous to 1848, we had been almost exclusively dependent on the gold washings of the Russian empire, situated chiefly at the base of the Ural mountains, for our supplies of this metal. In 1845 the yield of the world was 130,000 lbs., of which Russia furnished nearly one-half, or forty-seven per cent. In 1852, although the amount produced in that country was about the same, yet, relatively, it was only one-twelfth of the grand total of the world, which was over 700,000 lbs. troy. At the beginning of the present century there were forty-seven pounds of silver produced for one of gold; during the last few years the relative weight of the two metals has been about four of silver to one of gold—an astonishing change, and one which has been productive of momentous consequences all over the world.

Although the gold mines of the Northern Atlantic States have continued to be worked during the past few years, their yield has been but trifling compared with that of this State. Recently the California hydraulic method has been introduced in the Georgia gold fields, and great expectations are entertained of an increased production when it is fairly at work. The discovery of the precious metal in the Rocky mountains, the Pike's Peak region, so-called, in 1857 and 1858, caused a great excitement for a time; but the results have hardly equalled the expectations. It would appear from the most reliable information which I can obtain, that the yield of that district, during the past year has not much exceeded two millions of dollars. A great number of quartz mills have been put in operation there; but few have paid their expenses. Discoveries of gold have been made at various points to the south of Pike's Peak, but in a region infested by hostile and warlike Indians. The upper Missouri country is also reported by various exploring parties as a rich auriferous district. Time will show how important these new discoveries really are.

The future of the gold-mining interest of this State is connected with many questions of the greatest importance to California, as well as to the world in general. As the placer diggings become less productive, the quartz-mining business will continue to develope itself, and must become in time the leading interest of the State. Everything bearing on the opening of new mines, the improvement of the crushing, separating and amalgamating processes, should be studied with the greatest care during the progress of the survey.

Although the metalliferous ores are more attractive to the explorer than the earthy minerals, such as coal, salt, gypsum, and lime, yet the aggregate value of the latter, dug up from the bowels of the earth, far exceeds that of the former. A few favored regions, of comparatively limited extent, supply the world with the metals it requires for use; but of fuel, building materials, and other earthy substances used in agriculture and the arts, we consume an immense bulk, and every State must produce the principal portion of them within her own borders, if she is to rank high in wealth and population. What an enormous amount of building materials are consumed in a great city, and how much of comfort, as well as of splendor, depends on the facility with which these can be obtained. See how those cities which are the world's wonder, like London and Paris, are surrounded with, and built upon, everything which the architect and the manufacturer can demand! What prodigious interests are involved in the supply of coal—that prime mover of the arts, manufactures and commerce! Look at the map of Europe, and see how its coal fields have become the centers of its densest and most active population! How forcibly England's power is put before us by the figures of her coal production, 70,000,000 of tons a year, and steadily increasing, 350,000,000 tons nearly in the last five years. Think of the power generated by the consumption of this prodigious mass of material; the wheels within wheels set in motion; the endless ramifications of manufactures dependent on the supply of cheap fuel; the steamships plowing every ocean, and doing half the carrying business of the world! It is not cotton that is king; but coal. We must bow the knee too a sooty power greater than all others. In the world's game of life, it is the black diamonds which will always turn up trumps.

The United States, as a nation, is second to no other in the extent and value of its coal-fields, although we have hardly begun as yet to develope this portion of our national wealth. Pennsylvania has increased her production of anthracite in the last twenty years from 175,000 to 10,000,000 tons; but the vast resources of the other Middle and Western States remain as yet almost untouched; hundreds of thousands of square miles are underlaid by coal-beds, which extend in a vast and almost unbroken sequence from the Atlantic border to the base of the Rocky Mountains.

These coal deposits must be traced across the plains and mountains to the Pacific coast, and they must be opened and worked along the line of intercommunication of the two sides of the continent, the position of which must and will be finally determined, not by sectional requirements, or stock-jobbing, log-rolling maneuvers, but by physical and geological adaptations, in which old King Coal will certainly play the "leading violin."

The great deposits of coal throughout the world, although not absolutely limited to any one geological formation, are developed on a much larger scale in the rocks of two widely different epochs—the palæozoic and the tertiary. It is to the latter class that the coal beds of the Pacific coast belong, as far as yet discovered. Although the tertiary coal-bearing rocks are known to extend all along the coast, from Southern California as far north at least as Vancouver Island, no coal beds of any magnitude have been opened and worked within the limits of this State until quite recently. From what hasty examinations I have had an opportunity of making within the last few days, it appears that there is every reason to believe that workable deposits of coal, of fair quality and great extent, exist in Contra Costa county, in a very favorable position for mining and shipping to all points in the interior of the State. The analysis which I have made shows that this coal, of which there are several distinct beds, is well adapted to most of the purposes for which this substance is required. It is a matter of congratulation that the State will soon cease to be dependent upon other regions for her supplies of fuel. The peculiar composition of the California coal fits it admirably for burning in such a climate as exists here; as it may be managed so as to furnish a bright, cheerful flame, or to smoulder quietly away, giving out a gentle heat, and keeping on fire for a long time. The amount of ash it leaves behind is very small, varying from one to five per cent.

From the geological structure of the State, it would appear probable that many other coal-beds will be discovered in the coast ranges, and perhaps in the foothills of the Sierra Nevada. Whether any coal of palæozoic age occurs in the northern part of the State, as has been supposed, remains to be demonstrated, and a careful search will be made for it wherever rocks of that part of the series may be discovered.

In the development of the various materials necessary for building purposes, there is a large field of useful labor open to the geological corps. The best localities for opening quarries must be selected, and the various products submitted to practical tests and chemical analysis to ascertain their relative durability and value. Every year will add to the importance of this branch of the resources of the State. Railroads are to be built, public buildings erected, streets paved, rivers bridged, and all kinds of public works carried on, and every discovery of materials suitable for such purposes will add to the wealth of the State and promote general comfort and prosperity.

Having thus glanced at the present state of the mining interests of this country, as compared with other parts of the world, let us, in conclusion, briefly consider the more important features of a geological survey of the State of California on the basis laid down in the Act of the Legislature authorizing this work, and show how her mineral and agricultural resources are to be developed by it, if future Legislatures see fit to carry on the undertaking on a scale worthy the importance of the ends which it is desired to accomplish.

1. TOPOGRAPHY.

First, as a necessary basis on which to lay down our observations, and as an essential part of the work before us, we desire to do all that is possible toward preparing a correct map of the State. A complete and accurate map of a large region is, as all know, the work of much time and great expense. I need only refer to the Government topographical surveys of France, Great Britain, Austria, Prussia and other European States, which have been going on for many years with untiring patience and skill. Our own coast survey, a work in which all the refinements of modern science are concentrated, under the admirable supervision of Professor Bache, is a sample of what it costs in time and money to prepare a thoroughly accurate map. Massachusetts and New Jersey are the only States of the Union in which topographical surveys have been commenced.

In Massachusetts, the extent of whose territory is hardly more than one-twentieth of that of California, the work, although executed on a small scale, compared with that of the English and French surveys, and with the most rigid economy, cost over one hundred thousand dollars. In New Jersey the expense was found to be beyond the means of the State, and the work has been temporarily suspended. A correct map, however, is a matter of so much importance to the public welfare, that every highly civilized community must have one, when it reaches a sufficient development of its wealth and population. It is much to be regretted that the surveys carried on under the direction of the General Land Office at Washington were not more reliable, and also that geological observations were not connected with the geographical, as might be done without any great increase of expense ; but the vast extent of our territories, and the rapidity with which the land has to be brought into market, to supply the demand of settlers and speculators, have induced the adoption of a system under which accuracy is sacrificed to economy, and incompetence and dishonesty have too often made matters worse, leaving a fearful amount of confusion and litigation as a harvest for the future.

Although it will be many years before this State will undertake a thorough topographical survey, yet we can and must have a map greatly superior to any now capable of being furnished; without it we shall be unable to lay down our work with any approach to accuracy, especially in that part of the State over which the Land Office surveys have not been extended. It will therefore be necessary to make numerous accurate determinations of our geographical position by astronomical observations; and as much topographical work must be done as can be, with the means at our disposal, without interfering too much with the strictly geological duties of the survey. We ought to work up with care and furnish detailed maps of such portions of the State as are of special importance on account of the nature and extent of the mineral deposits which they contain. Geographical information must be collected and collated from every source, with the great end in view of making the final map of the State as complete as possible, both geographically and geologically.

2. PHYSICAL GEOGRAPHY.

No geological report of a State like California can be considered as complete, unless accompanied by a full investigation of its physical geography, especially as connected with the agricultural development of the State. Under the term " physical geography," I include everything connected with the configuration of the surface, the elevation, direction and distribution of its mountain ranges; its drainage—including all the phenomena of its springs, lakes and rivers; the peculiar composition of their waters; the relations of the land to the ocean; and furthermore, the climatology of the State; the conditions regulating the distribution of heat and cold, moisture and dryness, winds and storms, and all those circumstances by which the agricultural character of a region is determined: these ought all to be ascertained by long-continued and careful observations of the necessary instruments at numerous stations. This must be effected in conjunction with what has already been done by the United States Government, at the various military posts, as well as by the Smithsonian Institution. There is a large amount of disjointed material scattered through various official publications, which should be collected, and the general results brought together and made available for the people of the State.

3. AGRICULTURAL RESOURCES AND BOTANY.

Next in order comes the deveolpment of the agriculture and botany of the State.

We propose to furnish as complete a catalogue as possible of all the plants growing in California, together with such observations on their economical value and application to the daily wants of life as may be collected during the progress of the survey. Such species as prove to be new will be described and figured with care. The geographical distribution of the forest trees; the size and abundance of the different kinds suited for building purposes; the possibility of introducing and disseminating new varieties, or of increasing the number of those which are native to the State: these are topics of importance which deserve thorough study. The character and composition of the soil; its adaptation to various crops; the best methods of irrigation; sources of fertilizers; means of amendment; drainage—all these subjects will come up for investigation in the course of the survey.

Professor Brewer, who has this department in charge, has had the advantage of the instruction of the most eminent agricultural chemists in Europe, including Liebig and Bunsen, and had just been placed at the head of the New York State Agricultural College at the time the survey was organized. He was recommended by competent authority as being better fitted than any one else to take the direction of this branch of the survey, and it is a matter of congratulation that we have been able to secure his services.

4. ZOOLOGY.

The bill organizing the geological survey contemplates, in the fourth place, "a full and scientific description of its zoological productions." In carrying out this branch of the survey, we have, in the first place, to make a complete collection of all the animals which are found within the borders of the State, from the lowest in rank up to the most highly organized—from the humblest polyp to the most perfect vertebrate. These collections must be referred to competent authorities in the various departments of natural history, for investigation and arrangement. The new species must be described and figured, and all the information collected which in any way bears on the economical interests of the State. A large amount of work in this department has already been accomplished by the Smithsonian Institution, and the coöperation of the able naturalists attached to that great national establishment may be secured, no doubt, for our further investigations.

5. GENERAL GEOLOGY AND PALÆONTOLOGY.

The strictly geological portion of our great work may be properly divided into two sections: the first includes the general geology and palæontology; the second, the economical or applied geology. Under the first division we include all that relates to the general geological structure of the State, while the second embraces the practical application of the science to the wants and uses of the arts. Under the head of general geology we have to investigate the nature of the different rock formations, which are spread out in the valleys or piled up in the immense mountain masses which traverse the State. We endeavor to ascertain of what materials they are composed; how originally formed or deposited; what changes they have undergone since their deposition, and by what agencies these changes have been brought about. We search for and describe the fossil remains which the stratified rocks contain, and thus are enabled to compare them with the formations of other countries, and to fix their relative geological age and position. We then trace over the surface of the State, and lay down upon the map the range and extent, or the geographical distribution, of the different systems and groups of rocks, and exhibit their stratigraphical relations, or position with regard to each other, by means of sections showing the configuration of the surface and the character of the rocks beneath it, along certain lines measured and examined for that purpose. By these preliminary operations we are prepared with a basis on which to proceed with the next division of our work, namely:

6. ECONOMICAL GEOLOGY.

In this department of the survey our aim will be, as before stated, to discover and classify the mineral and metallic treasures which are buried beneath the surface of the earth; to ascertain their position and determine their abundance, so as to make them available for the industrial purposes of life. From the brief review which has already been given of the mining resources of the State, some idea may be formed of what discoveries are likely to be made of useful ores and minerals. No one can doubt that California is destined to take the highest rank as a mining State. All the more valuable metals occur here, and some if not all of them in unstinted quantity; and the requisite skill and capital will not be wanting for the development of the treasures which now lie hidden or imperfectly known, when the exact condition of things shall have been stated by official authority and with impartial and unbiased judgment.

7. METALLURGY.

This department of the survey includes everything connected with the separation of the metals from their ores, by the various processes of crushing, washing, amalgamating or smelting; in short, all those operations by means of which the useful metals are converted from the mineralized condition in which most of them occur in nature, to the metallic form in which they are ready to be made available in the arts. In the prosecution of our work, it will be our duty to afford all possible assistance to those who are engaged in mining, or desirous of obtaining information about the best methods of dressing and smelting ores. The various mineral products furnished by the different mines will be carefully analyzed, as also the substances used for fuel or fluxes; and the best methods to be employed with reference to the peculiar condition of each mining district will be studied out and laid before the public, with full details of the processes adopted in other countries, so far as they are applicable to this region. In every new mining district there is always a formidable crop of new inventions springing up for dressing and smelting the ores which are found there; these are often old methods reinvented—processes which have already been tried elsewhere and condemned, or such as are unsuited to the condition of things where they are attempted to be introduced. In such cases, a little disinterested advice may often be the means of saving much delay, trouble and expense to those anxious to know the real truth.

The system of having assays made of picked specimens, and of basing estimates on the one-sided and incomplete information thus obtained, is one which is almost sure to lead to misapprehension and pecuniary loss. The value of a vein or deposit of ore depends on a variety of conditions, of which its average richness is an important one, of course; but this element of the calculation is not by any means to be obtained from an assay of a single selected sample, and one should no more base an estimate on such imperfect data, than he should judge of the value of a house by an inspection of a chip from one of its timbers.

That a properly conducted geological survey will be of at least as much benefit to this State as any work of the kind has been to other regions, seems to me beyond a doubt. The great interest already manifested in the survey, both on the Atlantic side and in Europe, as evidenced by numerous letters from eminent men, received since it began to be spoken of, and the notices published in various influential journals, shows that its results will everywhere be looked forward to with anxiety, as throwing light on questions of the highest importance to the world in general, as well as to the State of California.

It is my firm intention that every person connected with the survey should have no other aim in view than that of advancing the interests of the State. Whatever information of importance is obtained in the course of our investigations, shall be used, not for private advantage, but for the public good. To pronounce an unbiased opinion on the value of a mineral deposit, calmly to weigh all the conditions necessary to its successful development, to keep cool among the brilliant visions which any new revelation of the treasures which mother earth keeps hidden within her bosom is sure to call up—all this demands that the observer should have that disinterestedness which can only be found in one whose pockets can be in no wise affected by the result. There is a feeling of intense pleasure in being the means of unfolding new scientific truths, and opening up new avenues to wealth which shall be open to all; and if our explorations should, as I trust they will, aid materially in developing the resources of this great State, I will cheerfully give the best years of my life to the work.

If I may be excused for speaking of myself as seems to me proper, standing as I do before those to whom I am most directly responsible, and who have a right to catechise me as their employé, I would say that, although for twenty years constantly engaged in the examination of mines and mining property, I have never been the owner of a share of mining stock or a foot of mining ground, or, either directly or indirectly, pecuniarily interested in any enterprise or undertaking in any way connected with the mining interest. If I were, I should consider myself as unfitted for the position I now occupy. If my services are to be of any value to the State, it will be because what I have to report will be the exact truth, as far as my brains will allow me to find it out; and I think too highly of the intelligence of those now before me, and of the citizens of the State generally, to believe that any other course will be considered as tending in the slightest degree to the permanent welfare of the State.

It is not alone in its positive deductions and actual discoveries that geological science may be of use to the State. There is a negative side to the question; and in a country where the go-ahead element predominates as largely as it does in this, one of the principal objects of a geological survey is to limit the field of research for minerals, and thus to check useless expenditures and prevent the throwing away of time and money in searching for that which cannot be found, or which, when found, will be of no use. There is so much excitement, so much of the lottery element, connected with the mining business, especially in a new country, that the disagreeable but necessary duty of quieting false hopes and excited expectations has often to be performed. There seems to be something connected with newly discovered mineral regions which magnifies their resources beyond all reason to the eyes of those who first visit them. A vein three inches wide is almost certain to have an apparent magnitude of at least three yards to the man who finds it, and it requires more than ordinary coolness of head to take into consideration all the elements of success, when standing over a newly opened deposit of ore. Hence, the first thing which every new mining region has to go through is its fever. Thus Lake Superior had, in 1845–7, its copper fever, which left the majority of persons who came within its sphere in a very low condition (as to purse) after the attack was over. Every other mining district opened in the country has been the scene of a similar feverish excitement and of wild speculation, which has often had the most disastrous effect on its development.

A vast amount of time, energy and money is often completely thrown away in misdirected explorations and hopeless mining operations. Means thus employed are as much lost to the State as if the amount in money which they represent had been sunk in the depths of the ocean. Before the geological survey of the State of New York was begun, and the fact demonstrated that no workable beds of coal existed there, as large a sum had been expended in boring and mining for that material as would have paid for the whole survey.

The amount of "prospecting," or exploring for metalliferous ores now going on in this State is astonishing; every hill and mountain valley, no matter how secluded, remote and forbidding, is being pried into. Not a grizzly bear in the densest chapparal is sure that indications of mineral will not be the cause of his being soon served with a peremptory notice of ejectment. It is a matter of no small importance that this work should be well directed; and it would seem that the geological survey had been instituted just at the right time, in this respect. We cannot possibly, ourselves, do all this preliminary work of exploration. Centuries would not be sufficient for our little band, of a dozen persons at most, to examine every square rod of the 160,000 square miles which make up the State; a territory as large as New York and all New England added to it. But there are probably ten thousand persons at work collecting materials for our inspection, and ready to direct our attention to important points; and in the interest of the State it will be our duty to examine, advise and report on what may thus have been discovered, as well as to discourage further explorations where there is evidently no prospect of success.

To use the geologist's motto—"Mente, manu, malleoque"—with head, hand and hammer, we will do our best to develope the resources of this great State, looking to you to furnish—as long as our work shall appear to be for the public good—the material aid and comfort necessary to carry out the plans I have laid before you; and for your patient attention to which, gentlemen, I beg leave to return my sincere thanks.

AN ACT

TO CREATE THE OFFICE OF STATE GEOLOGIST, AND TO DEFINE THE DUTIES THEREOF.

The People of the State of California, represented in Senate and Assembly, do enact as follows:

SECTION ONE. J. D. WHITNEY is hereby appointed State Geologist, whose duty it shall be, with the aid of such assistants as he may appoint, to make an accurate and complete geological survey of the State, and to furnish in his report of the same proper maps and diagrams thereof, with a full and scientific description of its rocks, fossils, soils and minerals, and of its botanical and zoological productions, together with specimens of the same, which specimens shall be properly labeled and arranged, and deposited in such place as shall be hereafter provided for that purpose by the Legislature.

SECTION TWO. Said State Geologist shall, as near as may be, at the beginning of each session of the Legislature, present to the Governor, who shall lay the same before the Legislature, a report of progress, in which the operations of the geological survey during the preceding year shall be set forth, and its more important practical results made public. He shall also furnish such estimates as he shall deem proper of the amount of appropriation which shall be required for the continuance of the survey. His report shall also embrace the amount of expenses incurred up to that period.

SECTION THREE. On the completion of the survey, the State Geologist shall prepare and present to the Governor a full and comprehensive report, embodying the results of the entire survey, with proper maps, diagrams and drawings of the same, and the Secretary of State is hereby directed to obtain the copyright for the same, as also of the annual reports of said geologist, for the benefit of this State.

SECTION FOUR. Whenever one or more volumes of the geological survey herein provided for shall be published, the Governor and Secretary of State may cause such books to be sold upon the most advantageous terms to the State, and any moneys derived from such sales shall be placed in the Common School Fund of the State.

SECTION FIVE. The said Geologist shall prepare for and superintend the publication of his reports of the final results of the survey provided for in this Act, and he shall present to the Legislature an estimate of the costs of such publication.

SECTION SIX. The State Geologist shall receive for his compensation the sum of six thousand dollars per annum, payable monthly, and his assistants shall receive such compensation as shall be determined upon by the Governor and said Geologist, which, together with the salary of the State Geologist, shall be audited by the State Controller and paid out of the amount herein appropriated, or out of such appropriations as shall be hereafter made for that purpose; provided that the compensation herein allowed shall be paid only from the time they shall enter upon the performance of their duties.

SECTION SEVEN. Whenever the said J. D. WHITNEY shall notify the Governor of his acceptance of the appointment herein made, the Governor shall cause to be issued to said WHITNEY his commission under the seal of State; and if the said WHITNEY shall decline to serve as said Geologist, or die, or become unable to prosecute said survey, the Governor of this State is hereby authorized to appoint some suitable person to prosecute said survey.

SECTION EIGHT. The sum of twenty thousand dollars is hereby set apart out of any moneys in the State Treasury, not otherwise appropriated, as a special fur for the payment of expenses incurred by said survey.

SECTION NINE. This Act shall take effect from and after its passage.

PHIL. MOORE, *Speaker of the Assembly.*

J. N. QUINN, *President of the Senate.*

Approved April 21st, 1860.

JOHN G. DOWNEY, *Governor.*

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